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Quaternary Glaciation: McMurdo Sound Region

This report is based on material furnished by Troy L. Péwé, Glacial Geologist, USNC-IGY, College, Alaska.

A common objective of many IGY studies in the Antarctic is to learn something of the history of the Antarctic ice cap. Meteorologists are gathering data on the whole range of ice-air-sun relationships. Glaciologists are studying the history of the continent in samples of snow and ice obtained from pits and by deep core drilling. Glacial geologists are seeking to fit the rock material deposited by glaciers into the geologists' calendar of the last few thousands of years.

One of the most obvious methods of learning something about the history of the ice cap is to study the evidences of past fluctuations of the margin of this continental glacier. Today, the ice cap spills into the sea or terminates at the sea around most of the continent. The record of ice-front fluctuations, then, lies mostly under water and at the present time is relatively inaccessible. In some areas, however, considerable ice-free land is present and the record of fluctuations of the fronts of both small and large glaciers is preserved.

One of the best localities to study the record of advances of both the outlet glaciers from the ice cap and the small alpine, or mountain, glaciers not connected with the ice cap is in the ice-free area surrounding McMurdo Sound. McMurdo Sound is at the southwest corner of the Ross Sea at 165°E, 77°S, in the shadow of the Royal Society Range (see Fig. 1).

Troy L. Péwé, glacial geologist, and Norman R. Rivard, assistant glacial geologist, spent most of the period December 1, 1957–February 10, 1958, in this ice-free area. Support in transporting men and supplies to the field by helicopter was provided by the US Naval Air Facility at McMurdo Sound. Aerial survey flights were made in US Navy aircraft. Glacial deposits were examined on Ross Island, Black Island, Brown Island, Mt. Discovery, and in the dry, ice-free valleys along the west side of McMurdo Sound—from Mt. Dromedary on the south to Gneiss Point on the north.

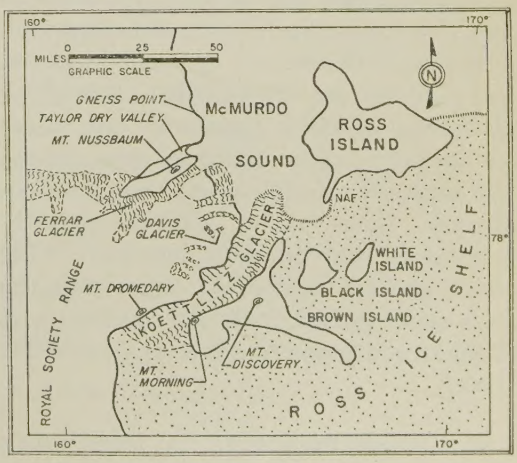

Fig. 1. *McMurdo Sound Region, Antarctica*

Glacial History

Evidence of at least three major Quaternary glaciations, each less extensive than the former, was found in the McMurdo Sound region. (A glaciation denotes a glacial advance and retreat represented by deposits and land forms distinguishable from those of different ages. The Quaternary period is the last million years of geologic time. It includes the Pleistocene and Recent epochs.)

Oldest Glaciation: The earliest glacial advance recognized in the region is indicated by patches of weathered rock material deposited by the glacier high on ridges and on elevated flat areas, such as those on both sides of the lower end of Davis Valley and near Mt. Nussbaum in Taylor Dry Valley. These deposits are 2000 ft above the valley floor. Many boulders have been abraded to the level of the ground surface by fine rock particles borne by the ever-present, strong winds. Ice of this glaciation filled all the valleys in the area and must have choked McMurdo Sound, banking at least 2000 ft up onto the surrounding terrain.

Intermediate Glaciation: Deposits of a succeeding glaciation are distributed widely around the Sound. Well-preserved but considerably wasted moraines (glacier-deposited rock material) of both outlet and alpine glaciers mark the extent of this glaciation. No sharp ridges exist and the moraines do not have cores of ice. Stones shaped by wind abrasion (ventifacts) are very well developed and boulders are wind-eroded. During this glaciation, in which there were two major ice advances, many alpine glaciers reached the expanded Koettlitz and Ferrar outlet glaciers; these alpine glaciers probably maintained their individual identities. Other alpine glaciers, however, merged with the huge outlet glaciers to fill the southern part of McMurdo Sound to an elevation of about 1000 ft.

Most Recent Glaciation: The latest major glaciation in the McMurdo Sound region is represented by the well-preserved, ice-cored moraines of the Koettlitz glacier. These are rich in volcanic materials. It is also represented by fairly well-preserved, granite-rich moraines of the alpine glaciers. Moraines of the large glaciers are characterized by many lakes and by fresh, or relatively unwasted, knob and kettle topography. The drift of small alpine glaciers is fresh but mainly represented by a thin boulder-filled clay. Ventifacts are well developed on moraines not cored with ice.

Lakes formed by blockage of valleys by glacial ice or moraines, but now drained, also existed during this latest major glaciation. The number and position of deltas in these former lakes suggest two, or possibly three, periods when the glaciers stood still or made only minor advances during this glaciation. Most alpine glaciers did not reach the sea or merge with the outlet glaciers; however, Koettlitz and Ferrar Glaciers pushed into McMurdo Sound.

Adjacent to many of the alpine glaciers are small, sharp-crested, ice-cored lateral moraines 50 to 100 ft high. These moraines are near the lower ends of the glaciers and in some places are compound. The moraines are extremely fresh and may represent minute ice advances during the last few centuries.

Regimen of Antarctic Glaciers

Comparison of the present positions of the fronts of many glaciers with their positions as shown in photographs taken 46 years ago by Griffith Taylor, a member of Scott's last expedition, reveal that little or no change has taken place in this interval. This is in sharp contrast to the movement of glacier fronts in both northern and southern temperate latitudes and supports the assumption that Antarctic glaciers have a sluggish regimen.

Conclusions

Examination of the glacial deposits in the McMurdo Sound region reveals that both the alpine and outlet glaciers have fluctuated

widely in thickness and extent in the geologic past, and at least three major Quaternary glaciations are recorded. The two groups of glaciers are now independent, but in the past they merged to fill McMurdo Sound with ice. At several times in the later part of the Quaternary Period many large lakes formed when valleys were blocked by glaciers or glacier moraines. These valleys now contain only small lakes, but high-level shorelines, deltas, lake clays, and evaporite deposits—soluble salts precipitated upon evaporation of a water body—remain to attest to the former existence and extent of these lakes. (One evaporite was identified as mirabilite, or Glauber's salt, $Na_2SO_4 \cdot 10 H_2O$.)

Although a Quaternary chronology of glacial advances and retreats, formation and destruction of lakes, and changes in sea level is recorded in the glacial materials of the McMurdo Sound region, no direct connection has yet been made with the glacial chronology elsewhere in the world.

Meteorological Rocket Soundings in the Arctic

This report is abstracted from material furnished by W. G. Stroud, US Army Signal Research and Development Laboratory, Fort Monmouth, New Jersey.

During the IGY, rocket soundings are measuring temperature, pressure, density, and winds at high altitudes in the Arctic. By the end of the IGY these soundings should yield enough data to provide a good understanding of the dynamic processes of the upper atmosphere.

Most of the US-IGY meteorological rocket soundings in the Arctic program are made from Fort Churchill, Canada (see *Bulletin 13*).

In the planning of the experiments at Fort Churchill, a guiding principle was that only proven rocket-borne techniques would be used. All techniques for observation used have been tested at the White Sands Proving Ground and have yielded significant data. The measurements have the added value of being made with the same methods in different geographic locations. Each of the techniques used, with a summary of observations, is described below.

Table 1 lists all experiments in the Arctic program and the locations and number of launchings up to June 1958. All of the US experiments, except that using the grenade technique, depend on telemetry (radio transmission of data to ground stations) from the rocket. Interpretation of most data depends on a knowledge of the trajectory of the rocket as obtained by the DOVAP system. DOVAP (Doppler-Veloc-

Table 1. *Arctic Meteorological Rocket Soundings*

Experiment	No. Launched	Location	Time
Sphere	8	North Atlantic & Churchill	W, D
Grenade	10	Churchill	W, S D, N
Aerodynamic	6	Churchill	W, S D, N
Gauge	3	Churchill	W, S D, N
USSR	6	Franz Joseph Land	W, D

Time code: W—Winter; S—Summer; D—Day; N—Night.

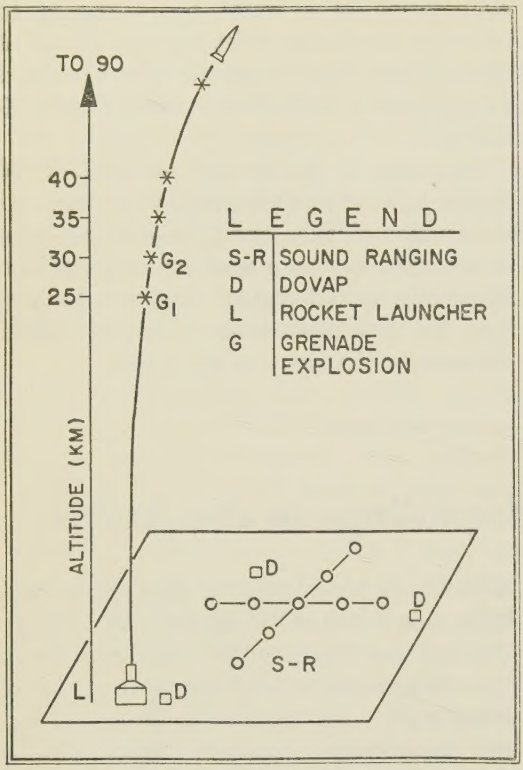

Fig. 2. *Instrumentation for the Grenade Experiment. The DOVAP stations track the rocket. The microphones determine azimuth and elevation of sound waves originating in high altitude grenade explosions.*

ity-And-Position) establishes the trajectory by measuring phase differences in the arrival of radio signals from the rocket at three locations (see Fig. 2). All data given here are preliminary and subject to modification.

The Freely-Falling Sphere Experiment

Technique: This method of measuring the density of the atmosphere was developed by a University of Michigan group under L. M. Jones, using first Aerobees and later Nike-Cajuns. In the present procedure, a 7-inch-diameter, 9-lb sphere is carried aloft. This is ejected from the Nike-boosted Cajun. As it falls through the atmosphere, its drag is measured by means of an internal accelerometer (see Fig. 3).

Atmospheric density is calculated from the equation:

$$\text{drag} = \tfrac{1}{2}\, D\, v^2\, C_D A,$$

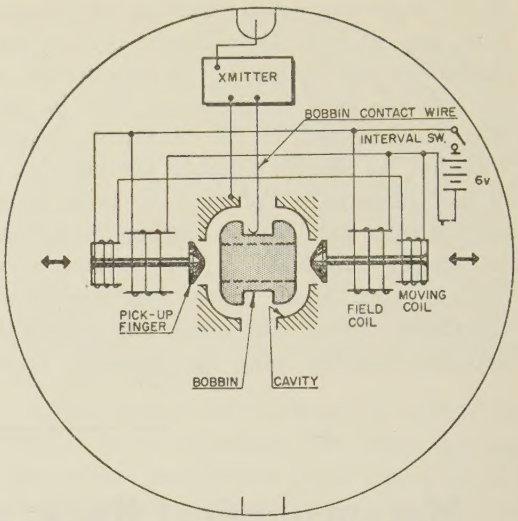

Fig. 3. *Diagram of Accelerometer in 7-inch Sphere. When the sphere is in free fall, the bobbin floats in the cavity. Drag acceleration causes the bobbin to move to the wall. The bobbin is centered and released by the pick-up fingers.*

where

D = density of air
v = velocity of sphere
C_D = drag coefficient
A = cross-sectional area

The drag coefficients are known from scaled wind-tunnel tests at low pressures. Velocity is obtained by timing the free-fall from peak altitude of the rocket. It is therefore possible, with the measurement of deceleration, to calculate D.

The altitudes for which the experiment is effective depend on the height from which the sphere is dropped, the ratio of the sphere's area to its mass, and the sensitivity of the accelerometer. The equipment now in use yields data for altitudes between 10 and 90 km. The accuracy is within 10% of the true value throughout this altitude range; its primary limitation is uncertainty regarding the values of the drag coefficients. Pressures and temperatures may be derived from the computed densities.

Results: Data are not yet available from the three falling-sphere experiments launched from Fort Churchill during the IGY. However, in a series of five Nike-Cajun

launchings in the North Atlantic in November 1956 as part of the pre-IGY test program, density measurements were obtained up to 80 km at three latitudes. One initial conclusion is that in this region of the atmosphere the density values are less in high latitudes than in lower latitudes.

These sphere samplings, taken at latitudes of 49°, 58°, and 66°N, when compared with sphere data from Wallops Island (38°N) and White Sands (32°N) suggest that air densities at 50 km vary markedly with latitude, decreasing about 2% per degree of latitude.

The Rocket-Grenade Experiment

Technique: The rocket-grenade experiments at Fort Churchill were conducted jointly by an Army Signal Corps group under W. G. Stroud and a University of Michigan group under L. M. Jones. In this experiment, the temperatures and winds of the upper atmosphere are measured by means of explosions of charges carried aloft and ejected from Aerobees. The positions and times of the explosions in space and the times and angles of arrival of the successive sound waves at the ground are recorded by an array of microphones (see Figs. 2 and 4).

The average temperatures in the levels between grenade explosions are calculated from the relationship:

$$C = \sqrt{\frac{\delta RT}{M}} = K(T)^{1/2},$$

where

C = the velocity of sound in the layer
δ = ratio of specific heats of air
R = gas constant
T = temperature
M = average molecular weight of air
K = constant over the altitude range

The average wind speeds and directions in the air levels between grenade explosions are determined by measuring the differences between the *true* positions of the explosions (obtained by DOVAP) and their *apparent* positions as given by the angles of arrival of the sound waves at the ground. Using this method, the measured temperatures are accurate to ±5°C and the winds to ±10 m/sec in velocity and ±18° in azimuth.

Results: The ten planned Aerobee-Grenade firings of the Churchill program have been successfully completed. Five winter firings and five summer firings were made. Some were in the daytime, some at night; on January 27, 1958, firings were made at midnight and at noon to measure the day's variation of temperatures and winds up to 90 km.

The reduction of the grenade data involves the determination of the positions of each of the grenade explosions from the DOVAP records and the calculation of the angles of arrival of the sound waves. The calculation of the temperature and winds from these elements has been programmed on an IBM 650 computer, which speeds up the final steps of the reduction. However, the DOVAP reduction for positions is done

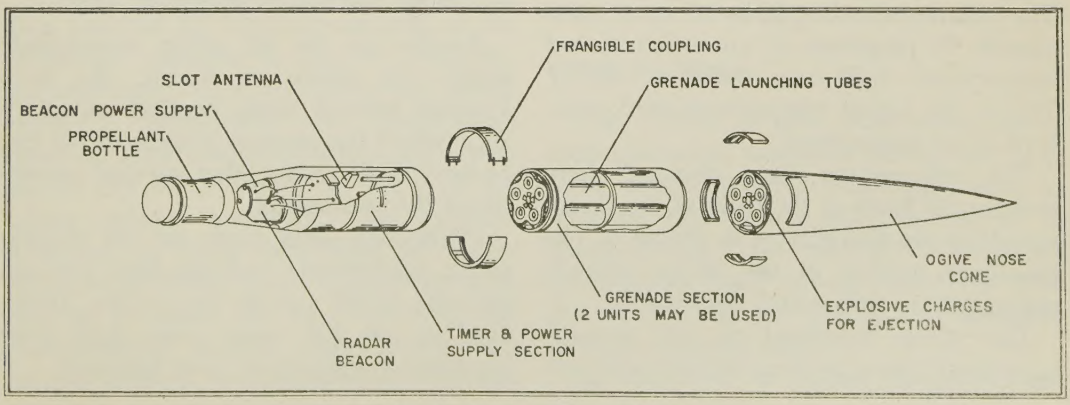

Fig. 4. *Rocket Used in Grenade Experiment*

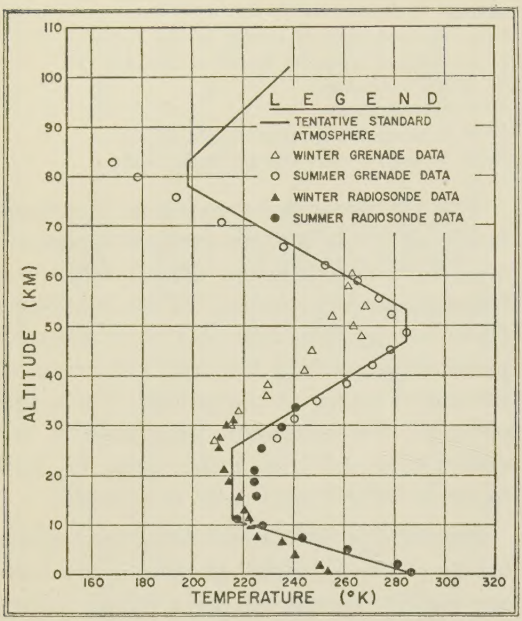

Fig. 5. *Upper Air Temperatures Measured by Grenade Experiment.*

by hand-counting the Doppler cycles, some 400,000 of them per launching; this takes several months.

Data obtained from launchings on November 12, 1956, and July 21, 1957, have been reduced. The preliminary results are shown in Figure 5. A difference between the summer and winter temperature distributions throughout the entire altitude region is shown. At 50 km, the spread is about 20°C; this is a significant amount. The winter measurement is characterized by low temperatures below 50 km and a broad, sporadic distribution from level to level. The summer sounding is, by contrast, quite smooth. It progresses to an extremely low temperature at 80 kms, 165°K (−108°C). This is the lowest temperature ever measured in the atmosphere.

The temperature data obtained from radiosondes flown at the times of the rocket soundings are also plotted in Figure 5. The soundings overlap in the 30-km altitude region and the data match quite well.

The winds measured in the grenade experiment have the characteristic summer-winter difference observed in lower latitude measurements. The winds are weak and from the east in the summer, very strong and from the west in the winter. A west wind of 150 m/sec (335 mph) was observed at a height of 58 km on November 12, 1956.

An additional finding of the Churchill launchings is the fact that above about 90 km the grenade experiment does not work. Even with four-pound explosives, sufficient energy cannot be transferred to the atmosphere to permit sound arrivals at the ground.

The Aerodynamic Experiment

Technique: In the aerodynamic experiment, a gauge mounted at the tip of the nose cone of the rocket measures stagnation, or ram, pressure. Other gauges measure pressure at the sides of the cone. N. Spencer of the University of Michigan has used alphatrons for these pressure measurements on both Aerobees and Nike-Cajuns. The alphatron uses a radioactive source of alpha particles to ionize the residual air between two collecting electrodes.

Pressure at the tip of the nose cone is, of course, much greater than on the sides because of the high speed of the rocket. The ratio of these two pressures is theoretically related to the Mach number, the ratio of the speed of the rocket to the speed of sound in the surrounding atmosphere. As the velocity of sound increases with temperature, the experiment therefore makes it possible to calculate atmospheric temperatures. The results are valid up to about 100 kms.

Results: As do all other experiments except the sphere experiment, the aerodynamic method needs detailed trajectory data before the pressure measurements can be used in evaluating other physical properties of the atmosphere.

Preliminary data from the six aerodynamic experiments indicate that between altitudes of 20 and 80 km in the Arctic, densities are 2–3 times lower than those measured previously at lower latitudes.

Gauge Experiments

Techniques: H. La Gow and his colleagues at the Naval Research Laboratory have applied earlier NRL work to measurements in the Arctic using Aerobee-Hi rockets. These measurements of pressure and density (from which temperature may be derived) are carried out as follows: Pressure gauges of various pressure ranges are scattered over the surface of the rocket, measuring stagnation and cone pressures, and pressures elsewhere on the rocket. The gauges measure pressures from 760 mm Hg to 10^{-6} mm Hg.

Roll modulation, or the change in amplitude of the gauge output with roll of the rocket, appearing on the side-cone gauges also permits the determination of the atmospheric pressure at higher altitudes (10^{-7} mm). These Aerobees are sealed throughout to prevent interior gases from leaking out. This permits an accuracy of measurement approaching the limits of sensitivity of the gauges.

This multiple-gauge approach has made possible measurements to much higher altitudes than the other techniques. Its accuracies, as given by NRL, are:

	Altitude	Error
Pressure data	25–80 km	5–15%
	110–150 km	20–50%
Density data	30–80 km	2–10%
	110–300 km	20–200%

Results: Since the accurate trajectory data required for complete analysis of the properties measured is not yet available, the reduction of data from the gauge experiments is incomplete and preliminary; however, three successful firings have been carried out at Churchill. As found in the falling sphere experiment, the densities measured are lower than those previously measured at White Sands. This seems to be true up to about 200 km. However, the measurements suggest that above this altitude summer day densities are 20 times higher than those of winter night, and winter day densities are 10 times higher than those of winter night.

Other Methods

Two other methods for measuring atmospheric density at rocket altitudes should be mentioned. Mass spectrometers for determination of gas and ion composition have obtained density data. Also, it has been observed in the grenade experiment that at the time of each explosion a period disturbance appears on the DOVAP-cycle record. This disturbance is apparently a measure of the velocity of the shock wave from the explosion. Since this is a function of air density, it becomes possible to determine the density at each grenade altitude. F. L. Bartman of the University of Michigan is at present working out this technique.

Time Variations: A specific problem in the comparison of the rocket data is that of time variations. Simultaneous measurements during the different experiments, although highly desirable, are difficult because of the limited space on the vehicles and the limited facilities for launching and tracking on range. However, at noon on January 27, 1958, an Aerobee carrying both the rocket-grenade experiment and a small sphere was launched. Twenty-nine minutes later a Nike-Cajun carrying the aerodynamic experiment was successfully launched. A comparison of the results from these three techniques will be particularly interesting and valid.

USSR Methods

The USSR is also conducting Arctic rocket-sounding programs during the IGY, using a meteorological sounding rocket to measure temperatures and pressures up to about 110 km. The USSR-IGY Committee has reported that between November 1957 and March 1958 six rockets were launched in Franz Joseph Land.

As described in Soviet literature, the

instrumentation consists of thermal and membrane manometers for measuring pressure, and an electric resistance thermometer for temperatures. An interesting feature of this technique is the use of a parachute throughout the entire downward leg of the trajectory to orient and slow the separated instrumentation section in its fall.

Previously published USSR results for the upper middle latitudes show general agreement with US-IGY results in this field.

It is still too early in the data analysis phase of IGY to draw broad conclusions. However, the prospect of obtaining meteorological data up to an altitude of 250 km at various sites throughout the world is excellent.

Ross Ice Shelf Deformation Project: 1957–58

This report is based on material furnished by James H. Zumberge, University of Michigan, Chief Glaciologist of the Ross Ice Shelf Deformation Project.

Along the margin of the Antarctic Continent are several ice shelves, thick ice formations with level surfaces, extending seaward from the land to which they are attached. One of these is the Ross Ice Shelf, the largest ice shelf in the world, extending about 500 miles in an east-west direction and 400 miles north-south.

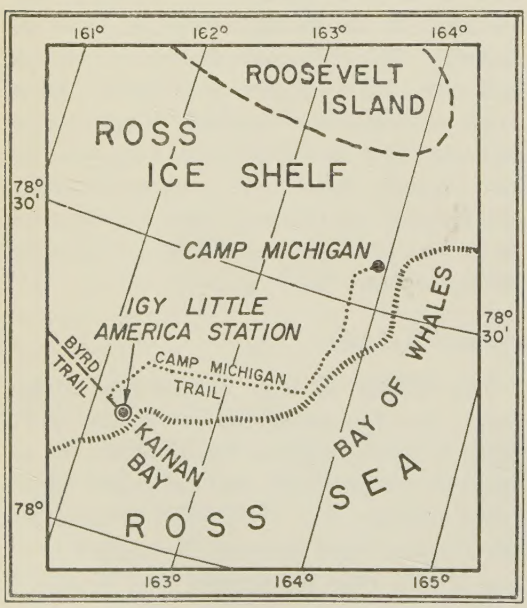

Fig. 6. *Location of Ross Ice Shelf Deformation Project, 1957–1958.*

The IGY Ice Shelf Deformation Project is concerned mainly with the measurement and mapping of deformed ice features of the Ross Ice Shelf between Roosevelt Island and the Bay of Whales. The deformation of shelf ice appears to involve some mechanism of plastic flow. If this mechanism can be determined for ice, it is possible that the results may be applicable to larger structures of the earth's crust, such as the folded Appalachians.

Camp Michigan, the base for these studies, was established on November 20, 1957, at 163°57.3′W, 78°34.0′S (see Fig. 6). The camp site is in the heart of a disturbed-ice area located by use of aircraft based at Little America Station, about 37 miles to the northeast.

During the 1957–58 Antarctic summer, Camp Michigan was supported by helicopter from IGY Little America Station. The camp itself was established by moving equipment and supplies from Little America with a 20-ton, tractor-drawn sled over a trail established November 12–15, 1957.

Scientific personnel consisted of a chief glaciologist, two assistant glaciologists, and a surveyor-photographer. A geophysical team spent approximately 10 days in the area taking seismological soundings and gravity measurements. Other temporary personnel included a Navy photographer and a Navy electronics technician.

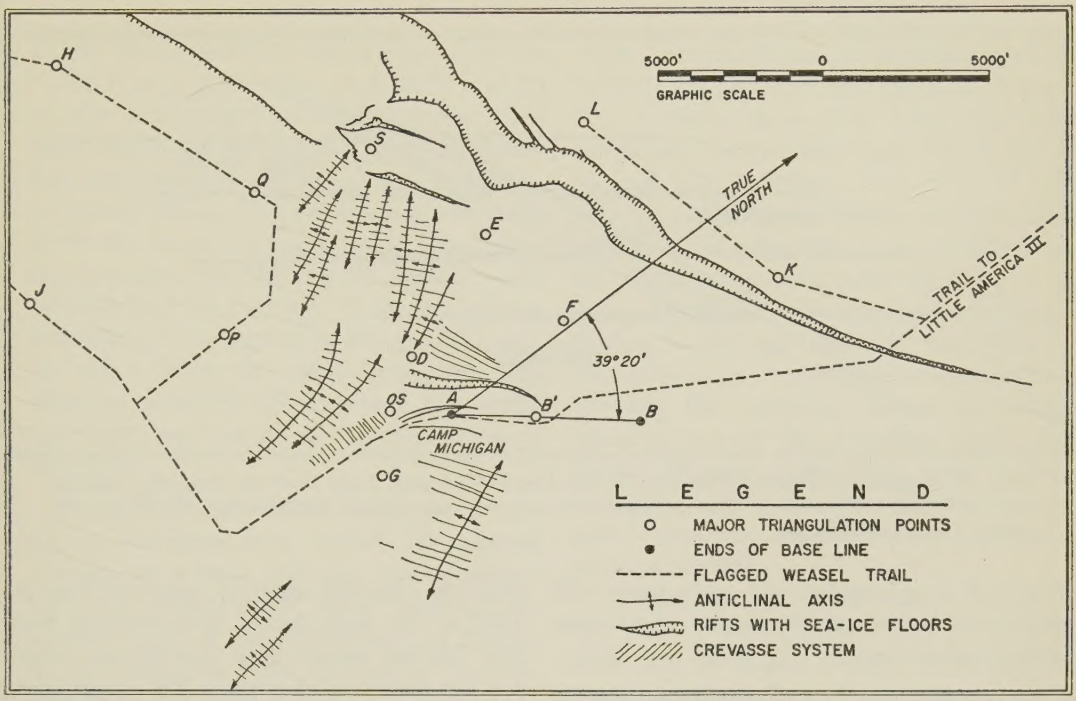

Fig. 7. *Preliminary Map of Major Structural Features of the Ross Ice Shelf Near Camp Michigan, Antarctica.*

Triangulation and Mapping

The first phase of the study involved the establishment of a base line and triangulation network. Seventeen stations in an area of approximately 25 square miles were located and surveyed. Vertical aerial photographs were taken from an altitude of 5000 ft with a 6-inch camera. The photos overlapped sufficiently for stereographic (three-dimensional) study and radial-line plots for the establishment of a network of points on the ice surface whose positions and distances with respect to one another are accurately known.

Large-scale topographic maps were made of selected areas (see Fig. 7). This will permit details of change in the shelf-ice surface to be recognized in subsequent years.

Deformational Features

Three types of deformational features were recognized: (1) anticlines (elongated upward folds) produced in the shelf ice by horizontal compression; (2) transverse crevasses cutting across the anticlinal axes, produced by horizontal tension; and (3) structures resulting from shearing motions in the ice.

Compressional Features: The anticlines (Fig. 8) are roughly parallel; they are about 15 to 50 ft high, more than 300 ft across, and 2000 to 5000 ft long. As many as four or five nearly parallel anticlines within one square mile are not unusual in this region. Most of the anticlines are symmetrical, but a large one seen from the air was definitely asymmetrical. The similarity of these structural features of the Ross Ice Shelf to folds in sedimentary rocks of the earth's crust is apparent.

Some idea of the rate of the horizontal strain causing the anticlines to form was gained by remeasuring the baseline. The baseline was essentially at right angles to the anticlinal axes. The original length of the baseline was 5800.0 ft; 42 days later it had shortened by 7.6 ft. Another measure-

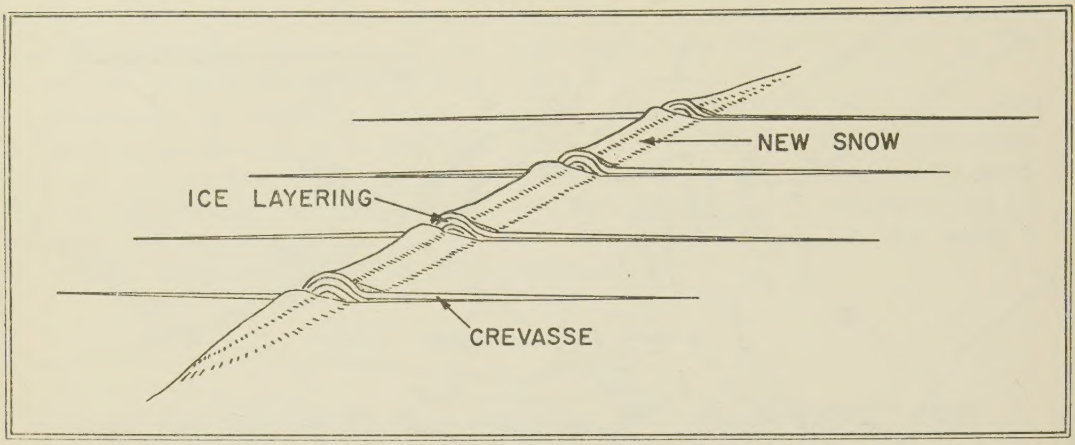

Fig. 8. *Diagram of Typical Anticline in the Camp Michigan Area. Note the layering exposed by the transverse crevasses. The individual ice layers, here greatly exaggerated, are mostly an inch or less in thickness.*

ment of the baseline one year later will provide a further check on the short-term compressional rate.

Tensional Features: Complementary to the compression-formed anticlines are evenly-spaced crevasses that cut across them at right angles to the anticlinal axes (see Fig. 8). These crevasses, produced by tension, range in width from a few inches to more than 100 ft. They are widest where they cross the anticlinal crests. Strain gauges calibrated to thousandths of an inch were installed in some of these crevasses; they showed that the rate of opening was constant, although rates differed from crevasse to crevasse. One small crevasse, 7.38 inches wide, opened 0.47 inches in 19 days. Another crevasse, 7.0 inches wide and 58 ft deep, closed at a constant rate, 0.235 inches in 25 days.

One crevasse not associated with the tensional crevasses was especially interesting because it contained a sea-ice floor 69 ft below the surface of the shelf ice. The sea-ice floor was broken by an 8- to 10-inch rift parallel to the trend of the crevasse itself, which was 41 inches wide at the bottom and about 5 ft wide at the top. The walls of the rift, 25 inches high, consisted of 9 small terraces. The width of the largest terrace was 2 inches.

The presence of the series of small terraces suggests that the ice shelf rose from time to time in this area; hence, it is assumed that the original sea-ice floor was formed when the ice shelf floated lower in the water than it did when the crevasse was examined. One possible explanation for the subsequent gain in buoyancy is that sea water was freezing onto the bottom of the ice shelf in this region. Investigations of similar crevasses that open to sea level will be made in the future to test this hypothesis.

At a depth of 25 inches below the sea-ice floor, free brine was encountered. A specific gravity test of the upper few inches of the sea-ice floor indicated a salinity of 7 ppm (parts/million) sodium chloride. Although the brine was not tested, it must have been highly concentrated since it remained unfrozen despite an atmospheric temperature at the bottom of the crevasse of about −20°C.

The walls of most of the crevasses observed did not contain secondary icing, or formation of ice subsequent to development of the crevasse, a common characteristic of crevasses in more temperate glaciers; for this reason, the walls of the ice-shelf crevasses showed excellent exposures of the ice strata.

Almost every crevasse in the study area is partially or completely covered by a snow bridge. These bridges range in thickness

from a few inches over the smaller crevasses to 12 ft over a crevasse 14 ft wide and 80 ft deep. The bridges are difficult to see when light conditions are poor but they are generally easy to detect when the sun is not obscured by clouds. In some areas of the shelf, however, the snow bridges are so thoroughly incorporated into the regular surface snow pattern that no evidence of the underlying crevasses can be seen from the ground, even on sunny days. In these areas, the only effective methods of detection are aerial inspection and use of an electrical crevasse detector.

Shear Features: Shear features in the Camp Michigan area consist of crevasse systems, in echelon patterns, not associated with anticlines. Other shear features are produced late in the developmental history of the anticlines when the strain rate increases to the point where plastic deformation is no longer possible. At that time the arched form of the anticline breaks into irregular blocks. The blocks are often not recognizable from the surface but can be seen by studying aerial photographs.

Snow Stratigraphy

Snow pit studies and examination of crevasse walls were initiated in November and December 1957. A 4-meter pit near Camp Michigan in an undisturbed area revealed a stratigraphic sequence of hard and soft layers representing accumulation back to the summer of 1951. The 1951 layer formed the bottom of the pit. At a depth of 270 to 271 cm from the November 1957 surface, an ice band marks the melting which occurred during the 1952–1953 summer. This melting provided free water that percolated downward through older layers, as evidenced by vertical ice pipes (elongated bodies of clear ice formed by refrozen melt water) below the 270–271 cm ice layer.

Snow accumulation from the end of the 1956 winter to the end of the 1957 winter was 48 cm, with an average density of 0.333. This is equivalent to about 16 cm of water. Accumulation for a similar period in 1955–56 had a water equivalent of 17 cm.

Two more snow pits were dug where horizontal compression had caused the ice to fold into anticlines. One of these snow pits was placed at the bottom of the syncline, or downfold, adjacent to an anticline and the other was placed near the crest of the same structure. Both the strata studied in the snow-pits and the layering visible on the walls of the transverse crevasses cutting through the anticline showed a marked thinning toward the anticlinal crest. This occurs because newly fallen snow is swept from the exposed crest by the wind, whereas accumulation is accentuated in the adjoining synclinal trough.

Comparison of accumulation values for the years 1951–57 in the two pits showed that the synclinal trough received 40% more accumulation than the adjoining anticlinal crest; but the trough received only 5% more accumulation than was measured during the same interval in the first pit, near camp, which represented normal accumulations in the absence of unusual surface obstructions.

The importance of stratigraphic studies in the deformed areas is similar to the importance of stratigraphy in structural geology. In this particular case, it is hoped that the walls of the transverse crevasses will yield a continuous record of snow layers back to a time before the anticlines existed, that is, before the presence of anticlines exerted an influence on the local patterns of snow accumulation. With this information it should be possible to determine the rate of anticlinal growth, or more specifically, the compressional strain rate in the area.

Density Depth Profile: A density-depth profile was made from the surface to the bottom of a 36-meter-deep crevasse. Samples were taken from the walls at intervals of one meter down to a depth of 25 meters; below this, the crevasse was filled with snow from an earlier, collapsed snow bridge, or bridges. By drilling through this material to

the bottom of the crevasse, the final density measurement was obtained. The density values comprising this profile, shown in Table 2, are representative for this area.

Table 2. *Density-Depth Values Near Camp Michigan*

Depth (meters)	Density (gm/cm³)
0	0.300
5	0.486
10	0.562
15	0.626
20	0.672
23	0.687
36	0.774

Thermal Studies

Thermohms (temperature sensing devices based on electrical resistance) were buried in the shelf ice at depths of 0.25, 0.50, 1.0, 2.0, 4.0, and 6.0 meters. Readings were taken once a day at 2400 GMT. A sample of the temperatures obtained is given in Table 3.

An additional temperature measurement was made at 24.5 meters below the surface in the wall of a crevasse near the camp. A probing dial thermometer inserted 3 inches into the crevasse wall in late November registered −25.0°C. (The snow bridge above the crevasse collapsed, precluding further measurement.) More temperature records will be made at greater depth during the 1958–59 season.

Meteorological Observations

Measurements were made every three hours (when possible) of temperature, barometric pressure, wind velocity and direction, cloud type, sky cover, and visibility. These records have not been completely analyzed. Generally speaking, however, the weather at Camp Michigan from November 21, 1957, to January 7, 1958, was mild. Temperatures ranged from a low of 5.0°F to a high of 34.5°F during this period. The sky was usually overcast to slightly overcast. Wind velocities ranged from 1 or 2 knots per hour to 25 knots. Winds of 15 to 20 knots were not uncommon in late November and December 1957. Prevailing winds were from the southwest but the strongest winds came from the northwest.

The strong winds and overcast skies caused difficulties in the surveying work with alidade and plane table. Overcast skies also made travel over the crevassed areas unsafe. The poor visibility prevented differentiation between snow-covered crevasses and the non-crevassed snow surface.

Future Program of Study at Camp Michigan

Camp Michigan will be reoccupied during the 1958–59 field season by a four-man team. The program of study inaugurated during the 1957–58 season will be continued and expanded. The work to be done will include the following:

1. Remeasurement of the baseline.
2. Resurvey of selected triangulation stations.
3. Aerial photography of the same area covered during the 1957–58 season.
4. Measurement of snow accumulation stakes placed in December 1957.

Table 3. *Ice Temperatures at Various Depths Near Camp Michigan*

Date	Time (GMT)	Temperature in −C°						
		Surface	.25m	.5m	1 m	2 m	4 m	6 m
24 Nov 57	2400	08.0	13.50	16.10	19.95	23.15	25.75	24.87
30 Nov 57	2400	05.0	12.35	13.85	17.70	22.40	25.60	24.87
4 Dec 57	2400	02.2	7.00	10.63	16.10	21.55	25.15	24.78
10 Dec 57	2400	06.5	9.36	12.02	15.16	20.40	24.76	24.64
14 Dec 57	2400	03.3	6.82	10.56	14.58	19.92	24.56	24.62
19 Dec 56	2400	02.6	5.58	9.26	13.62	19.18	24.16	24.52
23 Dec 57	2400	01.6	4.80	8.78	12.98	18.60	23.86	24.40
27 Dec 57	2400	02.5	4.66	7.86	12.48	18.12	23.60	24.18

5. Re-establishment of latitude and longitude by sun fixes.

6. Petrofabric studies (studies of the patterns produced by crystals) of the ice layers in deformed and undeformed areas.

7. Stratigraphic studies in snow pits and crevasse walls.

8. Further measurements of the rate at which crevasses are opening.

9. More detailed study of snow bridges and bottoms of crevasses.

10. Collection of more thermal data, with emphasis on deeper measurements.

11. Weather observations.

IGY Nuclear Radiation Investigations

The following material was furnished by Lester W. Machta and Robert List of the US Weather Bureau. Dr. Machta is chairman of the Working Group on Nuclear Radiation of the US-IGY Technical Panel on Meteorology.

At the Fourth Session of CSAGI (Special Committee for the IGY), held in Barcelona in September 1956, a recommendation by the Working Group on Nuclear Radiation to measure on a worldwide basis the radioactivity of the air, of precipitation at the earth's surface, and of solid particles deposited on the ground was endorsed.

Following endorsement of this recommendation, the Working Group met in Utrecht in January 1957. Problems related to nuclear radiation in the various fields of geophysics were discussed, and a simple collection and analysis program was formulated. The program includes establishment of a global observational network and preparation of a manual of observational standards and techniques.

The primary aim of nuclear radiation studies during the IGY is to utilize the radioactive "tracers" carried in the atmosphere and oceans to obtain a better understanding of many meteorological and oceanographic phenomena. This report describes portions of the US-IGY program of study of airborne and deposited nuclear radiation.

In addition to the information to be derived from the study of natural radioactivity, study of the artificially produced radioactive products of atomic fission and neutron-induced activities in the atmosphere is yielding much new data. With careful observation and analysis, important light may be obtained on atmospheric circulation, motions, and processes.

In this area are problems related to the identification and movement of air masses; the storage times of minute particles in the troposphere and stratosphere; exchange processes between the stratosphere and troposphere; small- and large-scale diffusion of atmospheric constituents; heat and moisture exchange between the atmosphere and the oceans; features of the large-scale circulation, including stratospheric transport; and the mechanism of precipitation scavenging —the removal of atmospheric particles by rain and snow.

US agencies participating in this program are the Atomic Energy Commission, the Geophysics Research Directorate of the Air Force Cambridge Research Center, the Naval Research Laboratory, the Public Health Service, and the Weather Bureau. In addition, cooperative agreements have been made with various agencies in other countries, especially meteorological services, to assist in sample collection and to participate otherwise in the program. With the exception of the Public Health Service program, most collections in continental United States are made at Weather Bureau stations.

Program of the Atomic Energy Commission

The New York Operations Office of the Atomic Energy Commission has two programs for collecting radioactive fallout. One consists of exposing one-square-foot sheets of gummed cellulose-acetate film on horizontal surfaces about three feet above the ground. Collections are made daily at 39 stations in the continental United States and cooperatively at 81 stations elsewhere in the world. At each station, the film is left exposed for 24 hours, then mailed back to New York. Here, the film is reduced to ash, placed in a plastic planchet and fed through an automatic counting device, where the total beta activity of the sample is determined.

The second program consists of continuously exposing to the atmosphere high-walled, stainless steel pots 0.82 square ft in area. Such pots are in use at 10 stations in continental United States and 16 elsewhere in the world. Each month, the contents of the pots, rinsed with distilled water if necessary, are bottled and shipped to New York for analysis of gross fission products, beta activity, and strontium-90 content. A gradual expansion of the station network is anticipated.

Program of the Public Health Service

The Public Health Service Radiation Surveillance Network, operating cooperatively with the Atomic Energy Commission, consists of 42 field sampling stations and a central laboratory. The central laboratory and three of the field stations are operated by the Public Health Service, the remainder of the stations are under the supervision of the appropriate state or territorial departments of health. Personnel are furnished either by the States or by cooperating local health departments.

Measurement of the concentration of fission products is made by filtering air through a four-inch-diameter dust filter at a rate of about 34 ft^3/min. Two sampling schedules are used: (1) continuous sampling for 24-hour periods, and (2) sampling on a timer-controlled schedule of one hour out of every three over a period of approximately 3½ days. The station operators estimate the activity on a filter and then send it to the laboratory in Washington, D. C., for counting. The filters are measured for beta activity with a thin-window, 7½-inch, gas-flow proportional counter. Each sample is counted at least three days after collection and again seven days later. On the basis of these two activity measurements, and assuming that the beta activity has decayed according to the Way-Wigner formula (radioactive fission products decay at a rate proportional to $t^{-1.2}$, where t = time from the formation of the products), the activity is extrapolated back to the end of collection.

Precipitation samples are collected by 20 of the network stations. When precipitation occurs, one sample is taken during each sampling period. The sample is collected in a bottle using a funnel 0.4 square meters in area. At the collection site, 0.5 liters of the collected precipitation is evaporated to dryness in a rectangular aluminum dish. The dish is then sprayed with plastic, flattened, and mailed to the central laboratory for counting. Activity is extrapolated back to the end of collection in the same manner as with the air filters.

Program of the Naval Research Laboratory

The program of the Naval Research Laboratory is carried out at a network of 20 stations extending along the 80°W meridian from Thule, Greenland, to Punta Arénas, Chile. Daily air-filter collections are made at all stations. In addition, four stations elsewhere are making weekly air-filter collections, and a complete air monitor unit is in operation at IGY Little America Station, in Antarctica. Cooperative agreements with the various participating governments and agencies are in effect.

Each station making daily collections is equipped with a positive-displacement air pump driven by a constant-speed electric

motor. This apparatus pumps about 30 ft^3 of air/min through a filter paper 8 inches in diameter. Filters are changed each morning and forwarded to the Naval Research Laboratory in Washington, where they are burned to ash at a temperature of 650°C, and compressed until wafer thin. Counting is done with a thin-window, halogen-filled G.M. tube. Each sample is counted 14 days after collection. Weekly collections are made with a larger filter (17 × 13 inches) having a flow rate of 35 ft^3/min.

Monthly composites of individual samples from each station are being analyzed for the following radioisotopes: Sr^{89}, Sr^{90}, Y^{91}, Cs^{137}, Ce^{141}, Ce^{144}, and Pb^{210}.

The equipment at Little America Station automatically monitors the filter during collection and follows the rate of decay during the next 18 hours. In this way, information is made available on natural radioactivity as well as on fission-product activity.

Program of the Air Force Cambridge Research Center

Six of the stations in the 80°W network of the Naval Research Laboratory program are also participating in the Cambridge Research Center program. At these stations, all of which have appreciable precipitation, the precipitation is collected and sent to a laboratory to be analyzed for Sr^{90}, Pb^{210}, tritium, and other individual radio-isotopes. Measurements of Sr^{90} are made on all samples; only selected samples are used for the other elements. In addition, snow cores and fresh snow from Greenland and the Antarctic are analyzed.

World Warning Agency Decisions

January 1, 1958—June 30, 1958

During the first six months of the IGY, 16 periods of Alerts and 7 SWI (Special World Intervals) were declared by AGIWARN, the IGY World Warning Agency, operated by the National Bureau of Standards at Fort Belvoir, Virginia, near Washington, D. C. (See *Bulletins 5* and *7* for details in this six-month period.)

During the next six-month period 11 Alerts were declared covering a total of 46 days and 6 SWI, covering 16 days, were declared.

Following are the Alerts, SWI, geomagnetic disturbances, and major flares that occurred from January 1, 1958, to June 30, 1958. Alerts and SWI are numbered serially from Alert number 16, which ended on December 29, 1957, and from SWI number 7, which ended on November 27, 1957.

Jan	*8*	*1600*	*Alert #17 starts*
	10	*1600*	*Alert #17 finishes*
Jan	*13*	*1315*	*Class 3 Flare*
	15	*1640*	*Class 3 Flare*
	23	*0904*	*Class 3 Flare*
	25	*0925*	*Class 3 Flare*
		0930	*Class 3 Flare*
		0935	*Class 3 Flare*
		1205	*Class 3 Flare; sudden ionosphere drop-out and gradual recovery*
	27	*1600*	*Alert #18 starts*
	29	*1600*	*Alert #18 finishes*
	31	*1155*	*Class 3 Flare*
Feb	*9*	*1600*	*Alert #19 starts*
	10–11		*Great aurora display, one of the most active periods of the IGY*
	11	*0126*	*Sudden commencement magnetic storm*
		0823	*Class 3 Flare, sudden ionosphere drop-out and gradual recovery*
	13	*15xx*	*Magnetic storm ends*
		1600	*Alert #19 finishes*
	26	*1600*	*Alert #20 starts*
	28	*1600*	*Alert #20 finishes*
Mar	*1*	*0911*	*Class 3+ Flare*
		0912	*Class 3 Flare*
		0916	*Class 3 Flare; sudden iono-*

			sphere drop-out, gradual recovery
Mar	*2*	*1600*	*Alert #21 starts*
	3	*1013*	*Class 3 Flare; sudden ionosphere drop-out, gradual recovery*
	5	*0001*	*SWI #8 starts*
		05xx	*Magnetic storm begins*
	6	*2359*	*SWI #8 finishes*
	7	*111x*	*Class 3 Flare*
		1600	*Alert #21 finishes*
	8	*15xx*	*Magnetic storm ends*
	11	*22xx*	*Magnetic storm begins*
	13	*19xx*	*Magnetic storm ends*
	14	*1212*	*Magnetic storm begins*
		1518	*Class 3 Flare*
		1600	*Alert #22 starts*
	15	*0001*	*SWI #9 starts*
		19xx	*Magnetic storm ends*
		2359	*SWI #9 finishes*
	16	*1600*	*Alert #22 finishes*
	20	*1600*	*Alert #23 starts*
	21	*0001*	*SWI #10 starts*
	23	*0950*	*3 Class 3+ Flares; sudden ionosphere drop-out, gradual recovery*
		0951	*Class 3+ Flare*
		0957	*Class 3+ Flare*
		1005	*Class 3 Flare*
		1009	*Class 3 Flare*
		1540	*Magnetic storm begins*
	25	*2359*	*SWI #10 finishes*
Mar	*27*	*02xx*	*Magnetic storm ends*
	30	*0001*	*SWI #11 starts*
		08xx	*Magnetic storm begins*
	31	*2359*	*SWI #11 finishes*
Apr	*1*	*1600*	*Alert #23 finishes*
	7	*1016*	*Class 3 Flare*
		13xx	*Magnetic storm ends*
		1600	*Alert #24 starts*
	10	*1600*	*Alert #24 finishes*
	17	*00xx*	*Magnetic storm begins*
	19	*00xx*	*Magnetic storm ends*
	30	*1600*	*Alert #25 starts*
May	*1*	*2115*	*Class 3 Flare*
	5	*0906*	*Class 3 Flare*
		1600	*Alert #25 finishes*
	13	*13xx*	*Magnetic storm begins*
	16	*02xx*	*Magnetic storm ends*
Jun	*3*	*1600*	*Alert #26 starts*
	6	*0001*	*SWI #12 starts*
		18xx	*Magnetic storm begins*
	8	*00xx*	*Magnetic storm ends*
		1600	*Alert #26 finishes*
		2359	*SWI #12 finishes*
	19	*0210*	*Class 3 Flare*
		0946	*Class 3 Flare*
		1600	*Alert #27 begins*
	20	*0001*	*SWI #13*
	21	*02xx*	*Magnetic storm starts*
	22	*2359*	*SWI #13 finishes*
	23	*08xx*	*Magnetic storm ends*
		1600	*Alert #27 finishes*
	28	*0713*	*Magnetic storm starts*
	29	*19xx*	*Magnetic storm ends*

IGY World Data Centers and Data Interchange

In accordance with the recommendations of the Third Assembly of CSAGI (Special Committee for IGY) in Brussels in 1955, three World Data Centers were established to maintain collections of IGY data. It was decided that three data centers would insure against the loss or destruction of the data and would serve the geographical convenience of scientists of all nations.

Two IGY National Committees, those of the USA and the USSR, each offered to establish and maintain collections of all the data. These centers were named A and B respectively. A third center, C, is in Western Europe, Japan and Australia. For several disciplines two subcenters of World Data Center C have been established, and are designated C-1 and C-2.

World Data Center A

World Data Center A was established in eleven institutions in eight cities of the United States and Alaska. The U. S. National Committee believes that the interests of science are served best by establishing subcenters for the various disciplines in the institutions which have a history of scientific interest and competence in the appropriate geophysical field rather than by establishing one central archive. The National Academy of Sciences is responsible for the direction of World Data Center A.

The subcenters of World Data Center A are:

(a) *Airglow and Ionospheric Physics:* Central Radio Propagation Laboratory, National Bureau of Standards, Boulder,

Colorado. Director: W. B. Chadwick, Chief of Regular Propagation Services Section of Radio Propagation Physics Division of the National Bureau of Standards.

(b) *Aurora (instrumental observations):* Geophysical Institute, University of Alaska, College, Alaska. Director: C. T. Elvey, Head of the Department of Geophysics and Director of the Geophysical Institute of the University of Alaska.

(c) *Aurora (visual observations):* Rockefeller Hall, Cornell University, Ithaca, New York. Director: C. W. Gartlein, Technical Advisor for Physics and Director of the Cornell Study of Aurora.

(d) *Cosmic Rays:* School of Physics, University of Minnesota, Minneapolis, Minnesota. Director: Paul J. Kellogg, Research Associate in the School of Physics, University of Minnesota.

(e) *Geomagnetism, Gravity and Seismology:* U. S. Coast and Geodetic Survey, Geophysics Division, Washington, D. C. Director: J. H. Nelson, Chief, Geomagnetism Branch, U. S. Coast and Geodetic Survey.

(f) *Glaciology:* American Geographical Society, Broadway at 156th Street, New York, New York. Director: William O. Field, Head of the Department of Exploration and Field Research, American Geographical Society.

(g) *Longitude and Latitude:* U. S. Naval Observatory, Washington, D. C. Director: William Markowitz, Director of Time Service, U. S. Naval Observatory.

(h) *Meteorology and Nuclear Radiation:* National Weather Records Center, U. S. Weather Bureau, Asheville, North Carolina. Director: Helmut E. Landsberg, Chief, Climatological Services, U. S. Weather Bureau.

(i) *Oceanography:* Department of Oceanography and Meteorology, Agricultural and Mechanical College of Texas, College Station, Texas. Director: Dale F. Leipper, Head, Department of Oceanography and Meteorology, Agricultural and Mechanical College of Texas.

(j) *Rockets and Satellites:* National Academy of Sciences, Washington, D. C.

(k) *Solar Activity:* High Altitude Observatory, Boulder, Colorado. Director: Walter Orr Roberts, Director, High Altitude Observatory of the University of Colorado.

Current Status of Data Flow

The current status of the flow of data to World Data Center A and of the interchange of data between Center A and the other World Data Centers is set forth below for each subcenter of Data Center A. The second "6-monthly" catalogue of data on hand in World Data Center A was issued on June 10, 1958. It may be noted that the flow of data most nearly approximates the CSAGI schedules in those disciplines in which there was organized international exchange of data prior to the IGY.

To date, World Data Center A has received data from 58 of the 66 nations participating in IGY including all of the larger nations. Data are also being received from stations and nations not formally part of IGY, and some data are being sent for times prior to the commencement of the IGY.

Airglow and Ionospheric Physics: The amount of data received in airglow projects is small at present because processing is laborious. A few months of data have been received from four nations. Some data have been sent to and received from each of the other World Data Centers. Since absolute calibration of IGY airglow photometers has now been completed, data for the first year of observations should reach the data center in the near future.

The flow of ionospheric data is immense. Data have been received from each of the other World Data Centers, and directly from 145 stations in 43 nations. Approximately 320,000 feet (61 miles) of ionogram film have been processed. The dispatch to other Data Centers of data received by Center A is fully current.

To date, fourteen requests for data have

been received, and several scientists have already visited Boulder to work with the data on the premises.

In addition to the CSAGI 6-Monthly Catalogue, an interim catalogue of data in Center A for airglow and ionospheric physics was issued in April.

Aurora (instrumental): Data from instrumental auroral studies are flowing more slowly than anticipated. More time has been required to process and reduce all-sky camera films and transmit them to the Data Center than was estimated in the CSAGI schedule. Nevertheless, at present, film has been received from 22 of the all-sky cameras operated by U. S. projects.

Aurora (visual): In the United States there are 424 active volunteer observers from whom 16,000 positive and 50,000 negative reports of auroras have been received. The US Weather Bureau has furnished 20,000 positive and 300,000 negative reports. From these reports, over 1000 auroral maps for 15-minute intervals have been drawn at the Regional Center at Cornell.

Data for the first eight months of IGY have been dispatched to the other World Data Centers. Data have been received from Data Center C. In addition, data have been sent directly to Center A from Argentina, Canada, Cuba, Mexico, and New Zealand.

Cosmic Rays: Data are flowing regularly to Data Center A from Centers B and C. Many stations send data directly to Center A. To date, data have been received at Center A from 21 of the 38 nations participating in the IGY program in cosmic ray studies.

The flow of cosmic ray data during the past five months has been more than five times as great as during the first six months of IGY. Approximately one-third of the stations are up-to-date in their transmittal of data to the centers.

Geomagnetism, Gravity, and Seismology: Magnetic data have been sent to Center A from nations in the Western Hemisphere for forwarding to the other World Data Centers. No data have been received directly from the other World Data Centers; stations which send primarily to these centers send also to Center A, usually through a collecting agency.

Geomagnetic data have been received from 86 stations in 27 of the 49 nations participating in the geomagnetic program. Many requests have been received for geomagnetic data, including requests for the data from the entire chain of variograph stations in the Western Hemisphere.

The flow of gravimetric data has been small as yet. Data sent to World Data Center A include earth tide studies at three stations in Japan and one station in Hungary.

Bulletins containing seismic data have been sent directly to Data Center A from stations or national collection agencies of 22 of the 52 nations which are participating in the IGY program. The bulletins received to date include data from 165 stations.

Glaciology: The flow of data to the subcenter for glaciology has been limited to progress reports from 13 glaciological projects in Canada, New Zealand, and the United States. The basic data for the field work accomplished during the first Antarctic summer, which ended in March of this year, is being compiled and should be transmitted to the Data Centers within the coming four months. This Center has issued the first volume of the World Data Center A Glaciology Report Series. This volume includes preliminary reports received by the Center prior to June 23, 1958.

Longitude and Latitude: Data from the two programs in longitude and latitude are reaching the appropriate primary data centers: astrolabe data to Paris, moon position data to Washington. These data will be reduced and published by the primary data centers. The flow of moon position data began only recently because of delays in starting the observation program.

Meteorology and Nuclear Radiation: Most stations submit data directly to World Data Center C. Data from stations in the Western Hemisphere have been forwarded to Centers B and C as required.

Center A has received data from 35 nations, including microfilm for three months of data from the USSR Data Center. A similar amount of microfilm has been dispatched to the USSR Data Center.

The flow of data to Center A from the stations in the United States and North America alone amounts to 25,000 punched cards per day—for the entire world network of stations the data will require about 100,000 cards per day. These data will be reproduced on Microcards by World Data Center C.

The pattern for the flow of data on nuclear radiation was established several months after the beginning of IGY. Center A has received data on nuclear radiation from eleven nations participating in this program.

Oceanography: Sea level data from ten countries have been sent to Data Center A. Cruise reports have been received from nine nations for 39 ships. Data have been sent to and received from World Data Center B. World Data Center A issued an interim catalogue of data received prior to April 1, 1958.

Rockets and Satellites: The CSAGI Guide outlining the operation of the Data Centers for rockets and satellites was issued in April 1958. Prior to this time, very little data had been received by this Center. Because of the nature of rocket and satellite data results, the agreed-upon timetable allows twelve months after completion of an experiment before data are expected. Data have been received at Data Center A from Denmark, Germany, Japan, South Africa, United Kingdom, United States, and USSR.

In order to make the results of rocket and satellite experiments widely available to interested scientists, Data Center A initiated two series of reports: one for rockets, one for satellites. Five issues of the satellite series and one issue of the rocket series containing preliminary data have been published. Some preliminary and informal reports have been received from the USSR, descriptive of their satellite experiments and early results.

Solar Activity: Data flow very promptly in this discipline. Center A has received data from 24 of the 36 nations participating in the solar activity program. In addition to the telegraphic data, written and tabulated reports are received regularly and promptly. Monthly lists of solar flares are dispatched by the 7th of the following month.

As part of the intermediate publication of data, Center A has published Solar Activity Report Series Numbers 1-3, "Reports of Surges and Active Prominence Regions," for the months of July 1957–March 1958.

Reports

In addition to the reports issued by the individual centers, a General Report Series has been established by World Data Center A. The first volume of this series is "Description of the Antarctic Circulation Observed from April to November 1957 at the IGY Antarctic Weather Central, Little America Station." This report is the work of Vladimir Rastorguev of the USSR and Jose Alvarez of Argentina, who spent one season at Little America.

The second volume of the IGY General Report Series is a preliminary report of the "Downwind Expedition" of the Scripps Institution of Oceanography of the University of California. The third volume includes three preliminary reports on the gravity and seismic programs at the University of Wisconsin.

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